Investigating predictor factors of echocardiographic data in renal failure in patients with acute heart failure

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ABSTRACT

Objective: The purpose of this paper is to investigate the predictor factors of echocardiographic data in renal failure in patients with acute heart failure. Acute heart failure was defined as the development of HF symptoms gradually or suddenly either in the form of a new onset or as a recurence that require emergency treatment and lead to the hospitalization.

Materials and Methods: This is a prospective study. 255 patients with diagnosis of acute heart failure were entered this study. Patients were under echocardiography after hospitalization. Creatinine was also measured daily and recorded, and the relationship between the echocardiography data obtained with its prediction was studied. **Results**: In this study, no significant correlation was found between echocardiographic data and intensity of renal dysfunction.

Conclusion: Finally, considering the importance of renal dysfunction in determining the prognosis of patients with acute heart failure, further studies are necessary to determine the effective factors in predicting the incidence of renal dysfunction.

Keywords: Echocardiography, renal failure, patients, acute heart failure

INTRODUCTION

In patients with heart failure, kidney failure is associated with a poor prognosis in these patients. Nevertheless, there is no consensus on whether renal dysfunction is the only symptom of deteriorating heart failure or it can be a factor in exacerbating heart failure. Although renal failure is commonly seen in patients with acute heart failure, some degree of renal failure is seen in 50% of the outpatients. Renal dysfunction in these patients is a strong predictor of mortality that factors such as LV dysfunction and NIHA-FC are stronger (1).

Acute heart failure with nearly three million referrals is one of the most important reasons of hospitalization of adults in Western countries (1).

Despite the advancement of therapeutic approaches and the availability of new drugs and tools, prognosis of patients is still not satisfactory. The mortality rate in hospitalized patients is about 3 to 4 percent and after discharge is close to 10 percent, and approximately 25 percent of the patients are hospitalized within 60 to 90 days after the initial visit (2).

Because of the close relationship between heart and kidney function, many heart failure patients are at risk of renal problems (3). So that about 50% of these patients shows some degrees of renal dysfunction (4). Renal dysfunction is one of the most important reasons for increased morbidity and mortality in patients with acute heart failure because it can worsen and develop cardiovascular diseases (5). The interconnection between the kidneys and the heart plays an important role in controlling arterial pressure, removing water and salt from the kidneys, arterial blood supply and oxygenation to tissues, and most importantly, the balance of extracellular fluid, including intravenous volume (5).

Disorder in the functioning of the kidneys, which occur in patients with acute failure, is called cardiorenal syndrome (CRS). (6).

Although the role of renal failure has been shown in worsening the prognosis in patients with acute heart failure, the exact pathophysiology is still ambiguous. Primary disease of kidneys, on the one hand and inadequate perfusion of kidneys due to inferior heart, increasing vasoconstriction, hypovolemia, and medication on the other hand, can be considered as an effective factor in the development of renal dysfunction (7).

Reducing renal perfusion, usually due to a decrease in cardiac output due to left ventricular failure, or increased central venous pressure (CVR) due to right ventricular dysfunction or TR, is likely to reduce renal perfusion by increasing renal vein pressure (9). In a study by Mider et al. (2011), it was shown that high TR and high CVP may play a role in renal dysfunction in patients with heart failure (10).

In another study, the relationship between RV dysfunction and renal failure in patients with heart failure was evaluated and this study showed that patients with Tapse <14 had less creatinine clearance (11). In another study, the relationship between MR severity and GFR in these patients was investigated and it was shown that these two relationships are inverse (12).

Limited studies have been conducted on the relationship between echocardiography criteria such as TR and MR in the development of renal failure in patients with heart failure. Therefore, this study examines the relationship between different echocardiographic criteria and the prevalence of cardio-renal syndrome in patients with acute renal failure.

Hypotheses

1- There is a relationship between LVEF and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
2- There is a relationship between MR severity and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
3- There is a relationship between TR severity and the progression of cardio-renal syndrome, the duration of hospitalization, and the need for renal replacement in patients with heart failure.
4. There is a relationship between S PAP and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
5- There is a relationship between TRG max and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
6- There is a relationship between RV size and progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
7- There is a relationship between IVC size and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
8. There is a relationship between Tapse and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
9- There is a relationship between LA area & volume and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
10- There is a relationship between RA area & volume and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
11. There is a relationship between diastolic indexes (E / E ', E', E / A, DT) and the progression of cardio-renal syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
12- There is a relationship between RV SM.TDI and the progression of cardiogenic syndrome, the duration of hospitalization and the need for renal replacement in patients with heart failure.
13-There is a relationship between the pre-hospitalization base creatinine, the dose of receiving diuretics during hospitalization, base blood pressure, the level of blood sodium at the time of entry, diabetes and infection, and the progression of cardio-renal syndrome, the duration of hospitalization, and the need for renal replacement in patients with heart failure.

Research Methodology

This study is a prospective study. 255 patients with diagnosis of acute heart failure in Shahid Rajaee Heart Hospital were entered the study. The criteria for selecting patients are Inclusion criteria, patients aged 15-70 years with diastolic failure with diagnosis of acute heart failure, exclusion criteria, Poor echocardiographic window, and any type of erythema that leads impairment in measuring echocardiography, patients who were under periodic dialysis.

The data collection tool included collecting echocardiographic data in patients with acute heart failure with cardio-renal syndrome. Patients were under echocardiography after hospitalization. Creatinine was also measured daily and recorded. An increase of more than 0.5 mg / dL was considered as a worsening of renal function. Finally, the relationship between the echocardiography data obtained with prediction of its creation was investigated. Chi-square or fisher's exact test, mann whitney and t-test are used to compare the groups. Multivariate analysis is performed to eliminate confused factors by using appropriate regression models such as logistic regression.

Research findings

Of 255 patients entered in the study, 57 patients (22.4%) were women, 198 patients (77.6%) were male. Patient echocardiography data are presented in the following tables. Of the 79 patients, 33% had decreasing of renal function.

Table 1. Patients' demographic information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	female	57	22.4	22.4	22.4
	male	198	77.6	77.6	100.0
	Total	255	100.0	100.0	

Table 2. Size of IVC

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	normal	81	31.8	32.0	32.0
	dilated	172	67.5	68.0	100.0
	Total	253	99.2	100.0	
Missing	System	2	.8		
Total		255	100.0		

Table 3. Size of RV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	normal	46	18.0	18.3	18.3
	mild	73	28.6	29.1	47.4
	moderate	89	34.9	35.5	82.9
	severe	43	16.9	17.1	100.0
	Total	251	98.4	100.0	
Missing	System	4	1.6		
Total		255	100.0		

Table 4. RV function

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	normal	21	8.2	8.4	8.4
	mild	46	18.0	18.3	26.7
	moderate	112	43.9	44.6	71.3
	severe	72	28.2	28.7	100.0
	Total	251	98.4	100.0	
Missing	System	4	1.6		
Total		255	100.0		

Table 5. Mitral regurgitation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	5	2.0	2.0	2.0
	mild	40	15.7	15.8	17.8
	mild to mod	35	13.7	13.8	31.6
	mod	61	23.9	24.1	55.7
	mod to sev	73	28.6	28.9	84.6
	sev	39	15.3	15.4	100.0
	Total	253	99.2	100.0	
Missing	System	2	.8		
Total		255	100.0		

Table 6. Tricuspid regurgitation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	3	1.2	1.2	1.2
	mild	22	8.6	8.7	9.9
	mild to mod	88	34.5	34.8	44.7
	mod	32	12.5	12.6	57.3
	mod to sev	51	20.0	20.2	77.5
	sev	57	22.4	22.5	100.0
	Total	253	99.2	100.0	
Missing	System	2	.8		
Total		255	100.0		

Table 7. Worsening renal function

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	176	69.0	69.0	69.0
	yes	79	31.0	31.0	100.0
	Total	255	100.0	100.0	

Table 8. Information on the echo of patients

	N	Minimum	Maximum	Mean	Std. Deviation
age	255	14	89	53.12	16.651
LVEF	255	5	55	19.76	11.448
Evelocity_A	240	.30	2.10	.9737	.39285
Avelocity_A	193	.19	3.30	.5686	.29782
EARatio	201	.5	4.2	1.951	.9453
EERatio	240	3	37	18.14	8.268
TAPSE	253	1	27	14.73	4.311
TRG	253	10	120	34.88	16.702
SystolicPAP	252	15	135	44.02	18.782
IVCsize	253	1.30	3.30	2.0893	.50004
Valid N (listwise)	192				

According to Table 9, there was no relationship between left ventricular failure and renal dysfunction.

Table 9. LV dysfunction and Renal function

			LVdisfunction		Total
			none severe	severe	
worseningRF	no	Count	81	91	172
		% within worseningRF	47.1%	52.9%	100.0%
		Adjusted Residual	-1.1	1.1	
	yes	Count	42	35	77
		% within worseningRF	54.5%	45.5%	100.0%
		Adjusted Residual	1.1	-1.1	
Total		Count	123	126	249
		% within worseningRF	49.4%	50.6%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.182[b]	1	.277		
Continuity Correction[a]	.902	1	.342		
Likelihood Ratio	1.183	1	.277		
Fisher's Exact Test				.337	.171
Linear-by-Linear Association	1.177	1	.278		
N of Valid Cases	249				

According to Table 10, there was no relationship between IVC size and renal dysfunction.

Table 10. IVC dilatation and Renal function

			IVC_dilated		Total
			normal	dilated	
worseningRF	no	Count	53	121	174
		% within worseningRF	30.5%	69.5%	100.0%
		Adjusted Residual	-.8	.8	
	yes	Count	28	51	79
		% within worseningRF	35.4%	64.6%	100.0%
		Adjusted Residual	.8	-.8	
Total		Count	81	172	253
		% within worseningRF	32.0%	68.0%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.620[b]	1	.431		
Continuity Correction[a]	.412	1	.521		
Likelihood Ratio	.614	1	.433		
Fisher's Exact Test				.468	.259
Linear-by-Linear Association	.617	1	.432		
N of Valid Cases	253				

According to Table 11, there was no significant relationship between right ventricular size and renal dysfunction.

Table 11. RV size and Renal function

			RVSize				
			normal	mild	moderate	severe	Total
worseningRF	no	Count	35	56	56	26	173
		% within worseningRF	20.2%	32.4%	32.4%	15.0%	100.0%
		Adjusted Residual	1.2	1.7	-1.5	-1.3	
	yes	Count	11	17	33	17	78
		% within worseningRF	14.1%	21.8%	42.3%	21.8%	100.0%
		Adjusted Residual	-1.2	-1.7	1.5	1.3	
Total		Count	46	73	89	43	251
		% within worseningRF	18.3%	29.1%	35.5%	17.1%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.103[a]	3	.107
Likelihood Ratio	6.165	3	.104
Linear-by-Linear Association	4.892	1	.027
N of Valid Cases	251		

According to Table 12, there was no significant relationship between right ventricular function and renal dysfunction.

Table 12. RV function and Renal function

			RVfunction				
			normal	mild	moderate	severe	Total
worseningRF	no	Count	17	38	75	43	173
		% within worseningRF	9.8%	22.0%	43.4%	24.9%	100.0%
		Adjusted Residual	1.2	2.2	-.6	-2.0	
	yes	Count	4	8	37	29	78
		% within worseningRF	5.1%	10.3%	47.4%	37.2%	100.0%
		Adjusted Residual	-1.2	-2.2	.6	2.0	
Total		Count	21	46	112	72	251
		% within worseningRF	8.4%	18.3%	44.6%	28.7%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.488[a]	3	.037
Likelihood Ratio	8.948	3	.030
Linear-by-Linear Association	7.473	1	.006
N of Valid Cases	251		

According to Table 13, there was no significant relationship between severity of mitral failure and renal dysfunction.

Table 13. MR and Renal function

			MR		
			mod to sev	sev	Total
worseningRF	no	Count	32	29	174
		% within worseningRF	18.4%	16.7%	100.0%
		Adjusted Residual	-5.5	.8	
	yes	Count	41	10	79
		% within worseningRF	51.9%	12.7%	100.0%
		Adjusted Residual	5.5	-.8	
Total		Count	73	39	253
		% within worseningRF	28.9%	15.4%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	51.930[a]	5	.000
Likelihood Ratio	67.902	5	.000
Linear-by-Linear Association	.708	1	.400
N of Valid Cases	253		

According to Table 14, there was no significant relationship between severity of mitral failure and renal dysfunction.

Table 14. Worsening of and Renal function & graded MR

			MR_graded		
			no	yes	Total
worseningRF	no	Count	115	61	176
		% within worseningRF	65.3%	34.7%	100.0%
		Adjusted Residual	4.4	-4.4	
	yes	Count	28	51	79
		% within worseningRF	35.4%	64.6%	100.0%
		Adjusted Residual	-4.4	4.4	
Total		Count	143	112	255
		% within worseningRF	56.1%	43.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	19.788[b]	1	.000		
Continuity Correction[a]	18.593	1	.000		
Likelihood Ratio	19.855	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	19.711	1	.000		
N of Valid Cases	255				

According to Table 15, there was no significant relationship between tricuspid failure and renal dysfunction.

Table 15. Worsening of and Renal function & graded TR

			TR_graded		
			no	yes	Total
worseningRF	no	Count	103	71	174
		% within worseningRF	59.2%	40.8%	100.0%
		Adjusted Residual	6.3	-6.3	
	yes	Count	13	66	79
		% within worseningRF	16.5%	83.5%	100.0%
		Adjusted Residual	-6.3	6.3	
Total		Count	116	137	253
		% within worseningRF	45.8%	54.2%	100.0%

	Value	df	Asymp. Sig (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	39.974[b]	1	.000		
Continuity Correction[a]	38.271	1	.000		
Likelihood Ratio	43.041	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	39.816	1	.000		
N of Valid Cases	253				

Discussion

In most studies that conducted on investigating the relationship between different echocardiography criteria and the prevalence of cardio-renal syndrome in patients with acute renal failure, it has been shown that increasing creatinine in patients undergoing acute heart failure is to worsening of prognosis in these patients. Gotelib et al showed that patients with creatinine increase at the time of hospitalization had prognosis worse than other patients. Heywood et al in a study conducted in 2004, found that patients with an increase in renal dysfunction had longer hospitalization and higher mortality rate compared with those with renal problem. In the present study, 31% of patients had renal dysfunction during hospitalization. Krumholz et al showed that in 28% of patients, renal function worsens during hospitalization.

In the present study, no significant correlation was found between echocardiographic data and the exacerbation of renal dysfunction. In this regard, Maeder et al in a study in 2008 on 196 patients hospitalized with acute renal failure showed that patients had Mod.TR and PV size larger than normal and RVSP over normal, e-GFR lower and Bun higher. Schrier et al. a study conducted in 2008 showed the relationship between severe TR and intensity of renal dysfunction.

Conclusion

Ultimately, considering the importance of renal dysfunction in determining the prognosis of patients with acute heart failure, further studies are needed to determine the effective factors in predicting the incidence of renal dysfunction. It seems that the inconsistency of the results obtained in this study with the results of other studies in this regard due to the inevitable use of multiple echocardiography devices with different image quality and performing echo by individuals, led to an interobserver error.

REFERENCES

1. Thom T, Haase N, Rosamond W, et al. Heart Disease and stroke statistics 2006 Update: are
port from the American Heart Association Statistics Committee and Stroke Statistics
Subcommittee. Circulation 2006; 113:e85-e151.
2. Gheorghiade M, Zannad F, Sopko G, et al. For the International Working Group on Acute
Heart Failure Syndromes Heart Fail Rev: Acute heart failure syndromes: Current state and
framework for future research. Circulation 2005; 112:3958-3968.
3. Bock JS, Gottlieb SS. Cardiorenal syndrome: new perspectives. Circulation 2010;121:2592-2600
4. Ezekowitz J, McAlister FA, Humphries KH, Norris CM, Tonelli M, Ghali WA, et al. The
association among renal insufficiency, pharmacotherapy, and outcomes in 6, 427 patients
with heart failure and coronary artery disease. J Am Coll Cardiol 2004; 44:1587e92.
5. Sarraf M, Masoumi A and Schrier RW. Cardiorenal Syndrome in Acute Decompensated Heart
failure. Clin J Am Soc Nephrol. 2009;4:2013-2026.
6. Heywood JT, Fonarow GC, Costanzo MR, Mathur VS, Wigneswaran JR, Wynne J. High
prevalence of renal dysfunction and its impact on outcome in 118, 465 patients hospitalized with acute decompensated heart failure: a report from the ADHRE database. J Card Fail
2007;13:422-430.

7. Fonarow GC, Heywood JT. The confounding issue of comorbid renal nusfficiency. Am J Med
2006;119:517e25.
8. Groves PH, Lewis NP, Ikram S, Maire R, Hall RJ. Reduced exercise capacity in patients with
tricuspid regurgitation after successful mitral valve replacement for rheumatic mitral valve
disease. Br Heart J 1991; 66:295e301.
9. Firth JD, Raine AE, Ledingham JG. Raised venous pressure: a direct cause of renal sodium
retention in oedema? Lancet 1988;1:1033e5.
10. Maeder MT, Holst DP, And Kaye DM. Tricuspid Regurgitation Contributes to Renal
Dysfunction in patients with Heart failure. Journal of Cardiac Failure 2008;14:824-830.
11. Dini FL, Demmer RT, Simionius A, Morrono D, Donati F, Guarini G, Orsini E, Caravelli P,
Marzilli M, Colombo PC. Right ventricular dysfunction is associated with chronic kidney disease and predicts survival in patients with chronic systolic heart failure. European Journal
of Heart Failure 2012;14:287-294.
12. Shutov AM, Kurzina EV, Serov VA, Ivashkina TN, Renal dysfunction and mitral regurgitation in
patients with chronic heart failure. Klin Med 2008;86:32-35.
13. Bruch C, Rothenburger M, Gotzmann M, Wichter T, Scheld HH, Breithardt G, Gradaus R.
Chronic kidney disease in patients with chronic heart failure-impact on intracardiac conduction, diastolic function and prognosis. Internation Journal of cardiology 2007:118:375-380.
14. Thom T, Haase N, Rosamond W, et al. Heart Disease and stroke statistics 2006 Update: are
port from the American Heart Association Statistics Committee and Stroke Statistics
Subcommittee. Circulation 2006; 113:e85-e151.
15. Gheorghiade M, Zannad F, Sopko G, et al. For the International Working Group on Acute
Heart Failure Syndromes Heart Fail Rev: Acute heart failure syndromes: Current state and
framework for future research. Circulation 2005; 112:3958-3968.
16. Bock JS, Gottlieb SS. Cardiorenal syndrome: new perspectives. Circulation 2010;121:2592
2600
17. Ezekowitz J, McAlister FA, Humphries KH, Norris CM, Tonelli M, Ghali WA, et al. The
association among renal insufficiency, pharmacotherapy, and outcomes in 6, 427 patients
with heart failure and coronary artery disease. J Am Coll Cardiol 2004; 44:1587e92.
18. Sarraf M, Masoumi A and Schrier RW. Cardiorenal Syndrome in Acute Decompensated Heart
failure. Clin J Am Soc Nephrol. 2009;4:2013-2026.
19. Heywood JT, Fonarow GC, Costanzo MR, Mathur VS, Wigneswaran JR, Wynne J. High
prevalence of renal dysfunction and its impact on outcome in 118,465 patients hospitalized with acute decompensated heart failure: a report from the ADHRE database. J Card Fail
2007;13:422-430.
20. Fonarow GC, Heywood JT. The confounding issue of comorbid renal nusfficiency. Am J Med
2006;119:S17e25.
21. Groves PH, Lewis NP, Ikram S, Maire R, Hall RJ. Reduced exercise capacity in patients with
tricuspid regurgitation after successful mitral valve replacement for rheumatic mitral valve
disease. Br Heart J 1991; 66:295e301.
22. Firth JD, Raine AE, Ledingham JG. Raised venous pressure: a direct cause of renal sodium
retention in oedema? Lancet 1988;1:1033e5.
23. Maeder MT, Holst DP, And Kaye DM. Tricuspid Regurgitation Contributes to Renal
Dysfunction in patients with Heart failure. Journal of Cardiac Failure 2008;14:824-830.
24. Dini FL, Demmer RT, Simionius A, Morrono D, Donati F, Guarini G, Orsini E, Caravelli P.
Marzilli M, Colombo PC. Right ventricular dysfunction is associated with chronic kidney disease and predicts survival in patients with chronic systolic heart failure. European Journal
of Heart Failure 2012;14:287-294.
25. Shutov AM, Kurzina EV, Serov VA, Ivashkina TN. Renal dysfunction and mitral regurgitation in
patients with chronic heart failure. Klin Med 2008;86:32-35.
26. Bruch C, Rothenburger M, Gotzmann M, Wichter T, Scheld HH, Breithardt G, Gradaus R.
Chronic kidney disease in patients with chronic heart failure-impact on intracardiac conduction, diastolic function and prognosis. Internation Journal of cardiology 2007:118:375-380.